Cosmology Without Origins

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Abstract

Modern cosmology has achieved extraordinary empirical success, but this success coexists with persistent foundational paradoxes. The standard model accurately fits a wide range of observations while simultaneously invoking global time, literal singularities, and an absolute origin; commitments that generate conceptual tension and remain weakly constrained by data. This paper argues that these tensions arise not from missing physics but from overcommitted interpretations. I propose a systematic reconstruction of cosmological inference that begins from a strictly minimal observational core and treats coherence, rather than causality or creation, as the primary explanatory constraint. I identify irreducible observables, systematic spectral shifts, a pervasive thermal radiation field, its remarkable spectral preservation, and the growth of correlated structure, and rebuild cosmology using only what is required for these facts to be mutually consistent. Within this framework, early global mixing and later differentiation emerge as coherence-maintenance strategies, while the cosmic microwave background is understood as a protected memory of an earlier regime. The Big Bang is thereby reinterpreted not as a physical origin but as a boundary of reconstructability marking the non-extendibility of the current coherence regime. The ΛCDM model is recovered as a powerful effective compression within this broader framework, but its surplus metaphysical commitments are shown to be optional rather than forced. The resulting coherence-first cosmology is empirically conservative and conceptually lean. It makes falsifiable claims concerning spectral purity, late-time interaction histories, and the limits of extrapolation, thereby remaining firmly within the domain of scientific theory rather than metaphysical speculation.

Keywords: cosmology, coherence, big bang, thermal relic, origin of universe, philosophy of cosmology, cosmological explanation, cosmic microwave background, spectrum preservation, structure formation

Methodological Reset

Modern cosmology operates at the edge of what can be directly observed, and any serious methodological account must therefore begin by clarifying what is legitimately taken as empirical input. An observable, in the strict sense adopted here, is not an inferred entity, mechanism, or global structure, but a stable pattern in the data, such as correlations among measured quantities, statistically robust distributions, and preserved structures that persist across large reconstruction depths. Examples include systematic relations between spectral features and distance, the existence and shape of large-scale radiation backgrounds, and the persistence of specific statistical regularities. By contrast, global primitives such as universal time parameters, absolute causal orderings, or literal spacetime expansion are not themselves observed; they are interpretive constructs introduced to organize these patterns. Methodological discipline therefore requires that such constructs be treated as provisional representations rather than as ontological givens, unless they are forced uniquely by the data. The burden of proof lies with any assumption that exceeds what is strictly required to account for observable regularities.

This distinction becomes especially important in cosmology because the field is unavoidably reconstructive. Unlike laboratory sciences, cosmology does not observe systems evolving under controlled repetition. Instead, it infers past regimes from radiation fields, matter distributions, and correlation patterns that encode information about earlier states. These relics are sparse, indirect, and filtered through long chains of inference. As a result, cosmological reasoning is structurally prone to over-interpretation. When a model successfully fits multiple data sets, there is a strong temptation to reify the representational scaffolding of that model, its coordinates, parameters, and extrapolated limits, as literal features of reality. Singularities, global beginnings, and universal clocks enter precisely in this form, not because they are observed, but because the mathematical form of the model encourages their reification. A methodological reset must therefore separate what is genuinely constrained by relic data from what is merely convenient for calculation or narrative continuity.

Within this context, coherence is introduced as the primary organizing principle for cosmological explanation. Coherence is understood operationally, not metaphysically. A system is coherent insofar as it exhibits stability under perturbation, persistence across its relevant ordering parameter, and preservation of future option-space, meaning that its internal organization allows continued evolution without catastrophic loss of descriptive or dynamical viability. Coherence in this sense is measurable indirectly, through the endurance of patterns, the suppression of unbounded divergence, and the emergence of structures that maintain their identity over extended reconstruction depths. Importantly, coherence is not defined in terms of equilibrium, entropy, or information alone, though it may intersect with all three. It is a higher-level constraint that captures why certain regimes persist while others dissolve.

Treating coherence as prior to causality, time, and ontology is not a philosophical flourish but a methodological necessity. Causal relations presuppose stable relata and repeatable ordering, both of which are already coherence-dependent. Time, when elevated to a global parameter, presupposes a regime in which ordering is uniform and extendable, something that cannot be assumed near the limits of reconstructability. Ontological commitments presuppose that the entities posited are stable enough to be meaningfully said to exist. Coherence, by contrast, can be identified without assuming any of these structures in advance. It concerns the conditions under which descriptions remain viable at all. By placing coherence first, cosmological explanation is reorganized around regime stability and transition, rather than around absolute beginnings or fundamental clocks.

This methodological reset does not deny the utility of existing cosmological models, nor does it claim that familiar constructs such as spacetime, expansion, or gravity are illusory. It insists only that their status be properly ranked. They are tools for compressing and navigating observable regularities within a coherence regime, not axioms that define reality itself. By enforcing this distinction at the outset, the subsequent reconstruction of cosmology can proceed with maximal empirical fidelity and minimal metaphysical excess, ensuring that any further commitments are introduced only when, and to the extent that, the data genuinely require them.

Minimal Observational Core

The empirical foundation of cosmology can be stated with far fewer commitments than are usually assumed. Once methodological discipline is enforced, its observational core reduces to a small set of non-negotiable regularities that any viable cosmological framework must accommodate. These regularities do not describe an origin, global history, or fundamental ontology. They describe stable patterns in the data that persist across independent measurements and observational strategies.

The first of these patterns is the existence of a systematic correlation between spectral features of distant astrophysical sources and their inferred separation from the observer. This correlation is direction-independent to high precision and exhibits a regular, monotonic structure over a wide range of scales. Crucially, the observable content of this fact is the existence of a consistent mapping between separation and spectral modification, not the mechanism by which that mapping is produced. No assumption of expanding space, metric structure, or global kinematics is contained in the observation itself. Such interpretations are representational choices introduced to explain the mapping, not elements of the data.

The second observational pillar is the existence of a pervasive radiation field whose spectrum is extraordinarily close to that of an ideal blackbody. This field is detected with remarkable isotropy and uniformity, modulated only by small, well-characterized variations. The significance of this observation lies not in its temperature scale or its historical interpretation, but in its form. A blackbody spectrum is the signature of a strong attractor, or a distribution that emerges robustly under a wide range of initial conditions when interactions are sufficiently mixing. The observation therefore demands that the radiation field once participated in a regime of effective thermalization, but it does not specify when, where, or how this regime arose.

Equally non-negotiable is the fact that this thermal spectrum has been preserved with extraordinary fidelity. Across vast reconstruction depths, the radiation field shows only minute deviations from the ideal Planck form. This long-term resistance to distortion places severe constraints on any processes that have interacted with the field since its formation. Whatever transformations have acted upon it must, in aggregate, lie very close to the

symmetry group that preserves the blackbody family, or else be so weak and sparse that their cumulative effect remains negligible. This preservation is data in its own right, not merely a corollary of the spectrum's existence.

The fourth element of our observational core is the growth of correlated structure from initially small inhomogeneities. Matter in the observable universe is not distributed randomly but exhibits hierarchical clustering and long-range correlations. These structures are consistent with the amplification of small variations rather than their spontaneous emergence at late stages. The observation requires that early variations persisted long enough to be amplified by some aggregating dynamics, but it does not, by itself, privilege any particular force law, temporal ordering, or global background.

Taken together, these four observations exhaust the empirical content that cosmology must explain at the most fundamental level. They constrain the existence of early mixing, later preservation, systematic propagation effects, and differentiation through amplification. Everything beyond them, including global time parameters, literal expansion of space, inflationary episodes, singular origins, or universal causal orderings, is an optional layer of compression. Such additions may be useful, even indispensable, for calculation and prediction within specific models, but they are not forced by the data themselves. Any cosmological framework that respects the distinction between observation and interpretation must therefore treat these four elements as fixed points and all further structure as provisional, revisable, and subordinate to empirical necessity.

Coherence-First Dynamics

A coherence-first account of cosmological dynamics replaces narratives of origin and causal succession with an analysis of regimes and the strategies by which they maintain stability. Rather than asking how the universe began or what caused it to evolve in a particular way, this approach asks how large-scale regularities can persist at all, given the constraints imposed by our minimal observational core. Dynamics are thus framed in terms of coherence maintenance and transition, not in terms of absolute temporal beginnings or privileged causal chains.

Two broad strategies for maintaining coherence can be distinguished, not as stages in a predefined timeline but as generic modes available to complex systems. In regimes where interaction density is high and distinctions are easily erased, coherence is most efficiently maintained by mixing. Rapid interactions homogenize distributions, suppress local variation, and drive the system toward attractor states that are insensitive to initial conditions. The existence of a pervasive thermal radiation field is a paradigmatic signature of such a regime. Mixing-based coherence is powerful, but it is also fragile. It requires sustained interaction dominance and becomes increasingly costly as the system differentiates.

As interaction dominance weakens and global homogenization ceases to be efficient, coherence is maintained instead by differentiation. In this mode, stability is achieved not by erasing variation but by allowing structured variation to persist and reinforce itself locally. Coherent subsystems emerge whose internal interactions dominate over their coupling to the background, thereby reducing the need for global correction. The growth of large-scale structure from small inhomogeneities reflects this shift. Differentiation does not represent a loss of coherence but a redistribution of it, from global uniformity to modular persistence across scales.

To describe this transition without reintroducing unnecessary metaphysical commitments, it is essential to avoid treating time as a global parameter. This framework therefore employs a regime-local ordering parameter that tracks change along reconstructable histories without assuming universal simultaneity or a single cosmic clock. This ordering parameter need only be monotone along the histories accessible to observation; it does not define a total ordering of all events, nor does it extend meaningfully beyond the coherence regime in which it is defined. Temporal notions familiar from standard cosmology are recovered, where appropriate, as representations internal to particular regimes rather than as fundamental structures.

Within this setting, dynamical change is characterized not by discrete events or sharp thresholds but by shifts in dominance among competing processes. What matters is not whether an interaction rate crosses a particular numerical value, but whether one class of

processes becomes generically more effective than another in maintaining coherence. Such dominance relations can change smoothly and irreversibly, without invoking critical moments, universal constants, or instantaneous transitions. Monotone shifts in dominance suffice to explain the emergence of new regimes and the stabilization of new structures.

This emphasis on dominance rather than thresholds allows the framework to reject the need for absolute constants or singular events as explanatory primitives. Constants appear as parameters internal to specific effective descriptions, while apparent events mark the limits of those descriptions rather than physical happenings in their own right. By grounding dynamics in coherence strategies and their reallocation, cosmology is recast as the study of regime stability and transition. Origins and ultimate causes are replaced by questions of non-extendibility and viability, yielding a dynamic picture that is both empirically constrained and conceptually restrained.

Thermal Relic as Coherence Memory

The most stringent empirical constraint in cosmology arises from the existence and persistence of a thermal radiation relic. A radiation field whose spectrum closely follows the Planck form is not merely a historical curiosity but a diagnostic of the dynamical conditions under which it was produced and preserved. A Planck spectrum is distinguished by its role as an attractor; under sufficiently strong and repeated interactions, a wide class of initial distributions are driven toward this form regardless of their starting configuration. The observation of such a spectrum therefore implies that, at some stage along our reconstructable history, the radiation field participated in a regime of intense mixing in which memory of prior spectral detail was effectively erased. This is not an inference about temperature, density, or chronology, but about interaction structure. The Planck form signals that mixing was strong enough, and sufficiently long-lived, to enforce universal distribution.

Once established, however, the same attractor logic imposes a second and even more restrictive requirement. If the radiation field had continued to undergo strong reshaping interactions, its present form would reflect ongoing equilibration rather than preserved memory. The fact that the spectrum remains extraordinarily close to the ideal Planck shape

across vast reconstruction depths therefore indicates that the regime of strong mixing did not persist indefinitely. Instead, the radiation field must have entered a phase in which the interactions capable of reshaping its spectral form lost dominance. In this sense, the thermal relic functions as a memory. It records the existence of an early mixing regime while simultaneously testifying to the long-term suppression of the very processes that produced it.

This inference motivates a minimal ecological classification of interactions. Some interactions are genuinely shape-changing, in that they drive distributions toward or away from equilibrium forms and actively erase spectral distinctions. Others are shape-preserving, acting only to rescale, redirect, or modulate radiation without altering its functional form. Alongside these sits a third ingredient, the background drift that characterizes the overall evolution of the regime and against which interaction effectiveness must be assessed. The relative dominance of these three elements, rather than their absolute magnitudes, determines whether a distribution is driven toward an attractor, preserved within its basin, or distorted beyond recognition.

Within this framework, what is often called “decoupling” or “last scattering” is reinterpreted. There is no need to posit a sharply defined event or surface at which interactions suddenly cease. What matters instead is a shift in dominance. Shape-changing interactions, once sufficient to enforce equilibration, become generically ineffective relative to background drift and to shape-preserving processes. This transition need not be instantaneous, globally synchronized, or associated with a particular spacetime locus. It is a regime change in which the radiation field ceases to be actively homogenized and instead becomes dynamically inert with respect to spectral form. The language of freeze-out thus refers not to the cessation of interaction per se, but to the loss of dominance of those interactions that would otherwise continue to overwrite the spectral record.

The extraordinary spectral purity of the thermal relic renders this reinterpretation unavoidable. Any viable cosmological framework must accommodate the fact that, after the attractor was reached, cumulative shape-distorting influences were either absent or suppressed to an extreme degree. Late-time physics is therefore tightly constrained.

Processes that act within the symmetry group of the Planck family, such as uniform rescalings, are permitted, as they preserve the spectrum's form. Processes that inject energy or redistribute it in a frequency-dependent manner are permitted only insofar as their net effect remains far below observational detectability. What is forbidden are sustained or recurrent regimes of global spectral reshaping after the thermal relic has formed, for such regimes would inevitably produce distortions that are not observed.

In this way, the thermal radiation field functions as a stringent filter on cosmological speculation. It does not merely support a narrative of a hot early universe; it enforces a specific structure on the universe's interaction history. The existence of a strong early mixing regime and the subsequent, long-lived suppression of spectral reshaping are not optional interpretive choices but empirical necessities. Any account of cosmological dynamics that violates these constraints, regardless of its elegance or explanatory ambition, fails at the most basic level of coherence with observation.

Shape-Preserving Symmetry and Spectral Shift

A crucial step in reconstructing cosmology from a minimal observational core is to recognize that the thermal radiation spectrum is not a single privileged curve but a one-parameter family of distributions. A Planck spectrum is defined not by a fixed numerical temperature but by a functional form that remains invariant under continuous rescalings of its defining parameter. This means that the blackbody distribution occupies an attractor basin rather than an isolated point in distribution space. Once a radiation field has entered this basin through sufficiently strong mixing, it can undergo certain transformations without leaving it. The empirical fact that the observed radiation spectrum is both thermal and stable therefore constrains not only the past existence of an attractor regime but also the class of transformations that can have acted upon the field since that regime ceased to dominate.

This observation naturally leads to the identification of a shape-preserving symmetry group. A transformation belongs to this group if it maps any member of the Planck family to another member of the same family without introducing additional structure. Uniform rescalings of frequency accompanied by the corresponding rescaling of the distribution parameter fall

into this category. Such transformations alter the scale at which the spectrum is expressed while preserving its functional form. Importantly, the existence of this symmetry is a mathematical property of the distribution itself, not a physical explanation of how or why the transformation occurs. To confuse the two is to mistake invariance for mechanism. The symmetry specifies what kinds of change are admissible without destroying the observed form; it does not dictate the ontology responsible for those changes.

When viewed through this lens, the systematic spectral shifts observed with increasing distance acquire a different status. The observable content of these shifts is that spectral features are transformed in a regular, direction-independent way along the observational path. That regularity, together with the preservation of spectral shape, implies that the dominant transformation lies within or very near the shape-preserving symmetry group of the Planck family. This inference does not require the assumption that space itself expands, nor that wavelengths are physically stretched by a metric background. Expansion is one possible realization of a shape-preserving transformation, but it is not uniquely selected by the data. Redshift, in this reformulation, is a coherent mapping applied to spectra, not direct evidence for a particular global kinematic interpretation.

The conceptual payoff of this reframing is significant. A single symmetry principle now accounts for three otherwise distinct observational facts, the existence of a thermal relic, the long-term preservation of its spectral form, and the systematic correlation between spectral modification and distance. Early strong mixing explains why the radiation field entered the Planck attractor basin. Subsequent dominance of shape-preserving transformations explains why the spectrum remains within that basin. The same class of transformations, acting cumulatively along observational paths, explains why spectral features are shifted in a regular and predictable way. No additional assumptions about global spacetime structure, absolute expansion, or universal clocks are required to unify these facts.

In this sense, shape-preserving symmetry functions as a powerful compression of our observational core. It replaces a collection of narrative explanations with a single structural constraint; whatever processes govern the propagation and evolution of radiation after

thermalization must respect the invariances of the Planck family to a very high degree. Standard cosmological interpretations remain valid as effective descriptions within this constraint, but they are no longer treated as uniquely privileged. What is fundamental, in this view, is not the particular story told about expansion or kinematics, but the condition that allows a thermal memory to persist while undergoing systematic, non-destructive transformation.

Anisotropies as Frozen Differentiation

The existence of small but highly structured anisotropies in the cosmic radiation field is often treated as a problem requiring additional dynamical machinery, most notably inflation. Within a coherence-first framework, however, anisotropies are not anomalous residues in need of special explanation but a natural consequence of how coherence is redistributed as a regime evolves. Their significance lies not in their mere presence, but in the specific way they coexist with an otherwise pristine thermal spectrum.

At the most minimal level, anisotropies are variations in the parameters of the Planck family across different directions in the sky. They do not represent departures from the blackbody form itself, but spatial modulations of its defining scale. In other words, the radiation field remains within the attractor basin identified earlier, while occupying slightly different points within that basin depending on direction. This distinction is crucial. The anisotropies are therefore not evidence of incomplete thermalization or spectral distortion, but of differentiated conditions imprinted within an already thermalized field.

Recognizing this immediately clarifies a common conceptual confusion; spectral purity and isotropy are governed by distinct processes. Spectral purity constrains interactions that change the functional form of the distribution, while isotropy constrains interactions that redistribute intensity across directions. A radiation field may cease to undergo shape-changing interactions and thus preserve its Planckian form, while still participating in angular interactions that partially homogenize or imprint directional structure. The near-perfect blackbody spectrum therefore places no requirement on the angular uniformity of

the field. Spectral freeze-out does not entail angular freeze-out, and the two must be treated independently.

Once this separation is made, the persistence of anisotropies admits a simple and general explanation. Angular mixing processes need not lose dominance simultaneously or uniformly across all scales. Instead, their effectiveness may diminish in a scale-dependent manner, allowing variations at certain angular scales to survive while others continue to be smoothed. In this view, there is no need to posit a single, globally defined "last scattering surface" at which all angular information is frozen at once. What is required is only that, along the reconstructable history of the radiation field, the processes capable of erasing angular contrast cease to dominate before all directional variation is eliminated. The resulting anisotropy pattern is then a frozen record of this partial and scale-dependent loss of angular homogenization.

This perspective has direct implications for the role traditionally assigned to inflation. Inflation is often invoked to explain why distant regions of the radiation field exhibit correlated anisotropies despite apparently limited causal contact. Such arguments presuppose a fixed global signal speed, a universal time parameter, and a sharply defined causal horizon. None of these assumptions are required within a coherence-first framework. Correlations need only reflect the interaction structure of the regime in which angular mixing was effective, not a specific causal story framed in global spacetime terms. As long as anisotropies were imprinted before angular mixing lost dominance, their large-scale coherence is unsurprising.

Consequently, inflation is neither refuted nor required. It remains one possible effective description of an early regime that enforces large-scale coherence, but it is no longer singled out by necessity. The observational data do not compel the introduction of superluminal expansion, special initial conditions, or a unique inflationary epoch. They require only that angular homogenization was once strong and later became insufficient to erase all contrast. By disentangling spectral and angular considerations and treating freeze-out as a gradual, scale-dependent process, anisotropies are integrated seamlessly into a coherence-first account. They mark the point at which differentiation begins to persist within a protected

spectral memory, rather than the failure of thermalization or the imprint of a uniquely privileged dynamical episode.

Structure Formation as Coherence Maximization

As a coherence regime evolves beyond the point at which global mixing dominates, the strategy of maintaining uniformity across the entire system ceases to be viable. Homogenization is effective only so long as the cost of erasing variation is lower than the cost of allowing it to persist. Once spectral reshaping interactions and strong angular mixing lose dominance, continued enforcement of global uniformity yields diminishing returns. Local variations, rather than being noise to be suppressed, become potential sources of stability. Attempts to re-homogenize them require increasingly fine-tuned coordination across scales, while producing little additional robustness. At this stage, coherence is no longer efficiently maintained by flattening differences, and the regime becomes structurally predisposed toward differentiation.

In this context, the emergence of structure is not an anomaly but a rational reallocation of coherence. A structure, in the most general sense, is a configuration whose internal interactions are sufficiently strong to maintain its identity against perturbations from the background. Such configurations function as local coherence reservoirs. They reduce the need for global correction by stabilizing themselves internally, thereby lowering the overall coherence-maintenance burden of the system. Persistence becomes a local property rather than a global achievement. Once such reservoirs form, their continued existence reinforces this differentiation strategy, as each stable structure further fragments the interaction landscape and diminishes the reach of homogenizing processes.

The growth of structure from small inhomogeneities thus reflects a one-way transition in how coherence is allocated. Early in the regime, coherence is global and enforced by mixing; later, it is distributed across an increasing number of locally stable subsystems. This transition is effectively irreversible, not because of an externally imposed arrow of time, but because reverting to global homogenization would require dismantling the very structures that now carry the system's coherence. The system would have to pay a prohibitive cost to

erase differentiated stability. In this sense, irreversibility arises from structural commitment rather than from entropy as a fundamental driver. Entropic descriptions may track this process, but they do not explain it.

Within this framework, gravity occupies a distinctive but non-privileged role. It is an exceptionally effective mechanism for amplifying small inhomogeneities under the conditions that prevail once mixing dominance has faded. Its long-range character and universal coupling make it well suited to aggregating matter into persistent structures. However, its effectiveness does not confer foundational status. Gravity is best understood as a contingent amplifier that becomes dynamically dominant when coherence is most efficiently maintained through aggregation rather than homogenization. Other mechanisms could, in principle, play an analogous role in different regimes or under different conditions, without altering the coherence-first logic.

By interpreting structure formation as coherence maximization rather than as the inevitable consequence of a particular force law, the emergence of galaxies, clusters, and large-scale structure is placed within the same explanatory framework as thermalization and freeze-out. All are expressions of how a system reallocates coherence as its interaction ecology changes. This perspective preserves the empirical successes of standard structure-formation models while avoiding the elevation of any single interaction to ontological primacy. What ultimately governs the large-scale organization of the universe is not a privileged force or a predetermined timeline, but the shifting balance between global correction and local persistence as the regime evolves.

What the Big Bang Actually Is

The persistent tendency to describe the Big Bang as a beginning reflects a deep category error in cosmological reasoning. The language of beginnings presupposes a global temporal framework within which something can be said to start, as well as a prior state relative to which that start is defined. Neither presupposition is warranted by the observational core of cosmology. What is observed are relics and regularities that permit partial reconstruction of earlier regimes, not a universal temporal axis extending without limit. To speak of the

universe as having begun is therefore to project a narrative grammar onto a domain where the conditions required for that grammar to apply are precisely what is at issue.

When cosmological models are extrapolated backward using their own internal variables, they encounter a point at which those variables cease to function coherently. Interaction rates diverge, densities lose operational meaning, and the parameters used to track change become undefined. This breakdown is often reified as a physical singularity. From a coherence-first perspective, it should instead be understood as non-extendibility. The descriptive regime that successfully accounts for present observables cannot be extended indefinitely without contradiction. The failure lies not in reality, but in the attempt to force a particular representational scheme beyond its domain of coherence.

Singularities, in this light, are not entities or events, but signals. They mark the point at which a model's conditions are violated. In mathematics, a singularity indicates the breakdown of a function's applicability; in physics, it plays an analogous role. Treating such breakdowns as literal features of the world mistakes a limitation of description for a feature of what is described. The appearance of a singularity therefore carries epistemic content. It tells us that the regime under consideration has reached the limits of its explanatory reach, but it carries no ontological mandate.

The Big Bang can thus be defined precisely and non-metaphysically as a coherence horizon. It is the earliest boundary of reconstructability implied by present observables, beyond which the interaction ecology, dominance relations, and ordering parameter that define our current coherence regime cannot be jointly maintained. It is not an event located at a point in time, but a boundary in the space of viable descriptions. On one side of this boundary lie regimes whose structure can be inferred, however indirectly, from preserved relics. On the other side lies a domain about which the current framework is silent, not because nothing exists there, but because the concepts required to describe it have lost their coherence.

This reinterpretation dissolves, rather than answers, the traditional origin question. It makes no claim about creation ex nihilo, nor does it assert that the universe emerged from nothing at a determinate moment. At the same time, it does not deny the possibility of other regimes, prior configurations, or forms of organization that do not admit description within the present

coherence framework. Such possibilities remain open, but they are not required by the data and cannot be specified without importing additional assumptions. A coherence-first account therefore occupies a deliberately constrained position. It refuses to infer more than what reconstructability permits, while resisting the temptation to convert descriptive limits into metaphysical claims.

Understood in this way, the Big Bang loses its status as a foundational mystery and assumes a more modest but more precise role. It names the point at which cosmological explanation must change its terms, not the moment at which existence itself was initiated. The origin problem is not solved by positing a beginning but dissolved by recognizing that the demand for one exceeds what the observable universe is able to support.

Comparison with ΛCDM

The relationship between the coherence-first framework developed here and the standard ΛCDM model is best understood as one of strict subsumption rather than competition. ΛCDM is an extraordinarily successful effective model, and nothing in my preceding analysis calls that success into question. On the contrary, a coherence-first reconstruction explains why ΛCDM works as well as it does, while also clarifying the limits of what its success can legitimately be taken to establish.

ΛCDM correctly captures the necessity of an early regime in which interactions were sufficiently strong to produce a thermal radiation field. Its treatment of a hot, dense early universe encodes, in representational form, the empirical requirement that the radiation field entered a robust attractor basin. Likewise, ΛCDM correctly enforces the long-term preservation of this relic by modeling a transition to weakly shape-changing interactions, thereby maintaining the near-perfect Planck spectrum observed today. Its account of the growth of structure from small initial perturbations is also empirically successful, reproducing the large-scale distribution of matter with impressive fidelity. Finally, ΛCDM's parameter economy and predictive efficiency make it an exceptionally powerful compression of a wide range of data into a tractable formalism.

These achievements, however, do not entail that the ontological commitments often associated with ΛCDM are forced by observation. The model assumes a globally defined cosmic time that orders all events and renders the universe describable as a single evolving system. It interprets systematic spectral shifts as evidence that space itself expands, rather than as one possible realization of a more general shape-preserving symmetry. It extrapolates its equations to a physical singularity and treats that extrapolation as a statement about the universe's origin. It further treats inflation as a necessary dynamical episode rather than as a contingent explanatory device introduced to preserve internal consistency under specific assumptions about causality and global structure. None of these commitments follow uniquely from the observational core; they are introduced to stabilize a particular representational scheme.

This coherence-first framework reveals that these commitments are optional rather than mandatory. ΛCDM can be recovered as a special-case compression within a broader generative structure. When the regime-local ordering parameter is represented as a global time coordinate, when the dominant shape-preserving transformation is represented as metric expansion, when gravity is selected as the primary aggregation mechanism, and when early coherence is enforced through a specific dynamical episode, the resulting description closely approximates ΛCDM. In this sense, ΛCDM is not wrong; it is a highly effective coordinate choice within a larger space of coherent descriptions. What it lacks is not empirical adequacy but foundational restraint.

The strictness of the subsumption lies in asymmetry. Every empirical success of ΛCDM is reproduced within a coherence-first framework, but the converse does not hold. The coherence-first account remains well-defined precisely where ΛCDM encounters conceptual breakdowns, such as singularities and absolute origins. Where ΛCDM requires auxiliary hypotheses to repair tensions generated by its own extrapolations, a coherence-first framework interprets those tensions as signals of non-extendibility rather than as physical pathologies. It therefore accommodates ΛCDM's results without inheriting its surplus metaphysics.

This contrast can be stated succinctly. ΛCDM treats the Big Bang as a physical origin; a coherence-first framework treats it as a boundary of reconstructability. ΛCDM treats time as a global parameter; a coherence-first framework treats ordering as regime-relative. ΛCDM treats expansion as literal ontology; a coherence-first framework treats it as one representation of a shape-preserving symmetry. ΛCDM treats inflation as necessary; a coherence-first framework treats it as optional. The empirical content remains the same, but the interpretive commitments are sharply reduced.

ΛCDM retains its full practical value while relinquishing claims it was never observationally entitled to make. This coherence-first framework does not seek to replace ΛCDM as a working model; it seeks to place it on a firmer conceptual footing by identifying which aspects of the model are demanded by data and which are artifacts of representational choice. In doing so, it preserves the predictive power of modern cosmology while dissolving the paradoxes that arise when effective descriptions are mistaken for literal accounts of reality.

Predictions, Constraints, and Falsifiability

A coherence-first cosmology is scientifically meaningful only insofar as it exposes itself to empirical risk. By refusing to insulate itself with unconstrained primitives, the framework developed here places strict limits on what can and cannot be accommodated. Its vulnerability is not a weakness but a consequence of its methodological discipline. The same constraints that allow it to dissolve traditional paradoxes also make it susceptible to decisive falsification.

The most direct threat to the framework would be the detection of substantial late-time spectral distortions in the cosmic radiation field that cannot be attributed to localized foreground effects or instrumental artifacts. Because a coherence-first account treats the thermal spectrum as a protected memory established by an early attractor regime, the cumulative reappearance of non-Planckian features would indicate either a resumption of globally effective shape-changing interactions or a failure of the freeze-out logic that

underpins the entire reconstruction. Either outcome would invalidate the claim that spectral purity functions as a long-term coherence constraint.

Closely related would be evidence for global re-thermalization after the emergence of large-scale structure. If observations were to show that the radiation field has been repeatedly driven back toward equilibrium at late stages, without erasing anisotropies or disrupting structure, the central claim that coherence must be reallocated away from global mixing would be undermined. Such a finding would suggest that mixing and differentiation can coexist indefinitely at the global level, contrary to the framework's core dynamical principle.

A different class of falsifier would concern temporal structure. If compelling evidence emerged for a globally meaningful time parameter extending smoothly beyond the reconstructable boundary identified as the Big Bang, the interpretation of that boundary as a coherence horizon would fail. This framework depends on the claim that extrapolation beyond this boundary leads to non-extendibility of the descriptive regime, not to a continuation of the same ordering variable. A demonstrable pre-boundary extension of global time would therefore directly contradict a coherence-first account.

Finally, the framework would be broken if the observed distance–spectral shift correlation were shown to require transformations that do not lie within, or arbitrarily close to, the shape-preserving symmetry group of the Planck family. If systematic spectral modifications were found that cannot be represented as coherent rescalings or symmetry-respecting mappings, the unification of thermal relic, preservation, and redshift-like behavior would collapse. In that case, the minimal observational core would no longer admit a single coherence-based explanation.

Where the coherence-first framework differs most sharply from standard cosmology is not in the data it accepts but in how it prioritizes their interpretation. Spectral distortion searches, often treated as secondary tests within ΛCDM, become central probes of interaction history. Even small deviations acquire foundational significance because they bear directly on whether the radiation field has remained within its attractor basin. Similarly, large-angle anomalies and horizon-scale irregularities are not immediately read as failures requiring new global dynamics, but as potential signatures of scale-dependent freeze-out or

incomplete angular homogenization. Apparent tensions are therefore redistributed from the level of ontology to the level of regime-specific interaction ecology.

Perhaps most importantly, expansion itself is reclassified. Observational success traditionally attributed to expanding space is interpreted here as evidence for a stable, shape-preserving mapping acting along observational paths. Expansion remains a valid and often convenient representation, but it is no longer elevated to an axiom. This shift alters not the predictions of effective models, but the interpretive commitments attached to them.

For these reasons, a coherence-first framework cannot be dismissed as metaphysics. It begins with observables rather than speculative entities, systematically reduces assumptions rather than multiplying them, and forbids entire classes of cosmological histories that would otherwise remain admissible. It makes claims that can be wrong and identifies the conditions under which they would be wrong. In doing so, it preserves the empirical successes of modern cosmology while restoring a clear distinction between what the universe is observed to do and what our models are permitted to say about why.

Mathematical Formalization

The coherence-first framework developed in this paper requires only a minimal mathematical structure, sufficient to formalize the observational constraints without importing unnecessary ontological commitments. The purpose of this section is not to derive detailed dynamics, but to specify the smallest set of relations that must hold for the preceding arguments to be internally consistent, empirically grounded, and falsifiable.

We will begin by introducing an ordering parameter, denoted χ, which labels stages along reconstructable histories inferred from present observables. No global temporal interpretation is assigned to χ. It is required only to be locally monotone along such histories and to support comparative statements about dominance and persistence. All subsequent quantities are functions of χ, and no claim is made about their extendability beyond the coherence regime defined earlier.

Let $f(\nu, \chi)$ denote the spectral distribution of a pervasive radiation field as a function of frequency ν and ordering parameter χ. The defining empirical fact is that, for a wide range of χ accessible to reconstruction, f lies arbitrarily close to the Planck family of distributions,

$$f_{\mathrm{P}}(\nu; \theta) \propto \left(e^{\nu/\theta} - \mathcal{N}(\theta)\right)^{-1},$$

where $\theta(\chi)$ is a single scale parameter. The significance of this expression is not its thermodynamic interpretation, but the fact that it defines a one-parameter attractor family in the space of distributions. $\mathcal{N}(\theta)$ is an arbitrary, dimensionless normalization encoding the choice of representative within the attractor basin and carries no independent empirical or explanatory significance beyond fixing scale.

To formalize the notion of attractor entry and memory preservation, introduce three effective rates. The first, $\Gamma_S(\chi)$, represents the aggregate influence of interactions that actively reshape the spectral form of f, driving it toward or away from the Planck family. The second, $\Gamma_A(\chi, \ell)$, represents angular redistribution processes at angular scale ℓ, which may alter directional structure without changing spectral shape. The third, $K(\chi)$, represents background drift, or the rate at which the conditions defining the regime change in a way that challenges equilibration.

The evolution of the spectral distribution may then be written in the schematic form,

$$\frac{\partial f}{\partial \chi} = -\Gamma_S(\chi)\ \Big(f - f_{\mathrm{P}}\big(\nu; \theta(\chi)\big)\Big) + \mathcal{S}(\nu, \chi),$$

where $\mathcal{S}$ collects all shape-distorting source terms. This equation is not proposed as a fundamental law, but as the weakest expression capable of encoding the observational fact that the Planck family is both an attractor and a preserved structure.

The existence of a thermal relic requires that there exist an interval I_{mix} of χ for which $\Gamma_S(\chi)$ dominates background drift,

$$\Gamma_S(\chi) \gg K(\chi) \ \text{ for } \chi \in I_{\mathrm{mix}},$$

ensuring convergence toward the attractor. The preservation of the relic requires that this dominance does not persist indefinitely. There must exist a later regime in which,

$$\Gamma_S(\chi) \ll K(\chi),$$

and in which the cumulative effect of $\mathcal{S}$ remains negligible. Importantly, no threshold value is implied by these relations; they express dominance, not equality, and may be satisfied continuously rather than at a discrete transition.

The distance–spectral shift correlation is captured by the existence of a transformation T_d, parameterized by separation d, such that,

$$f_{\mathrm{obs}}(\nu) = T_d[f_{\mathrm{emit}}](\nu),$$

with the empirical constraint that T_d maps members of the Planck family to members of the same family. This implies that T_d lies within, or arbitrarily close to, the shape-preserving symmetry group defined by,

$$f_{\mathrm{P}}(\nu;\theta) \mapsto f_{\mathrm{P}}\big(\lambda(d)\nu;\theta/\lambda(d)\big),$$

for some monotone function $\lambda(d)$. This relation formalizes the claim that systematic spectral shifts need not be interpreted as evidence for a particular spacetime ontology but must respect the invariances of the observed attractor.

Angular anisotropies are accommodated by allowing $\Gamma_A(\chi,\ell)$ to vary with scale and to lose dominance non-uniformly. The persistence of anisotropies requires only that, for some scales ℓ,

$$\Gamma_A(\chi,\ell) \lesssim K(\chi)$$

before angular contrasts are fully erased. No globally defined freeze-out surface or simultaneity condition is required.

Finally, the notion of a Big Bang boundary is formalized as non-extendibility. Let $\mathcal{R}$ denote the coherence regime defined by the joint applicability of $f(\nu,\chi)$, $\Gamma_S(\chi)$, $\Gamma_A(\chi,\ell)$, and $K(\chi)$. The Big Bang corresponds not to a point $\chi = 0$, but to the statement that there exists no extension of $\mathcal{R}$ to smaller χ for which these quantities remain jointly well-defined and mutually consistent. In this sense, the boundary is mathematical rather than physical. It is the limit of the coherence of the descriptive schema itself.

No additional formal structure is required. These relations are sufficient to (i) enforce the existence and preservation of a thermal relic, (ii) constrain admissible propagation effects, (iii) allow anisotropies and structure formation, and (iv) reinterpret the Big Bang as a

coherence horizon rather than an origin. Any further mathematical elaboration belongs to specific effective models, not to the foundational framework articulated here.

In Closing

This paper has argued that the enduring conceptual tensions of modern cosmology do not arise from a lack of empirical success, but from an excess of interpretive commitment. By returning to a strictly minimal observational core and reconstructing cosmological inference around coherence rather than causality, creation, or global time, I have shown that many familiar paradoxes, such as origins, singularities, and absolute beginnings, are not deep features of the universe but artifacts of representational overreach. When observational constraints are taken seriously and nothing more is assumed than what those constraints require, cosmology no longer demands a story of genesis in order to explain structure, regularity, or persistence.

Within this coherence-first framework, the thermal radiation field emerges as a central epistemic anchor; a preserved memory of an early mixing regime whose existence and stability impose severe restrictions on admissible interaction histories. The systematic correlation between distance and spectral shift, the survival of anisotropies, and the growth of large-scale structure all follow from a common logic of dominance shifts and regime transition, without privileging global spacetime ontology or discrete cosmological events. The Big Bang, in particular, is revealed not as a physical origin but as a boundary of reconstructability, marking the point at which the current coherence regime can no longer be extended without loss of descriptive stability.

The standard ΛCDM model is neither rejected nor diminished by this analysis. Instead, it is reclassified as a powerful effective compression within a broader generative framework. Its empirical successes are preserved, while its surplus metaphysical commitments are shown to be optional rather than mandatory. In this sense, coherence-first cosmology strictly subsumes the standard model, explaining both why it works and why it fails when pressed beyond its legitimate domain.

The resulting picture is deliberately restrained. It does not speculate about what lies beyond a coherence boundary, nor does it claim to resolve every open question in fundamental physics. What it does provide is a disciplined way of distinguishing between what the universe is observed to do and what our models are permitted to say about why. By restoring that distinction, cosmology is freed from questions it cannot meaningfully answer and refocused on those it can. The universe need not have begun in order to be intelligible; it need only be coherent enough to leave traces that endure.

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